

## Automated Traffic Law Enforcement System: A Feasibility Study for the Congested Cities of Developing Countries

Shormee Saha

Lecturer, Department of Computer Science and Engineering, Royal University of Dhaka,  
Banani, Dhaka, Bangladesh.

Email: 165shormee@gmail.com

### ABSTRACT

The population of the cities in developing countries are growing at a whirlwind speed. Industrialization and urbanization are making the crowd of these countries more city-oriented gradually. Most of these cities were not planned to cope up with a high growth rate of the population. Therefore, congestion occurs with a negative impact on every sector of the lifestyle. Regular traffic congestion in these cities is a remarkable problem which stabilizes the productivity and the national economy as well. An automated traffic enforcement system is not a new concept for any developed territory. But the implementation of such a system in any third world country is the real challenge. Cities like Kabul, Dhaka, Kathmandu, Lusaka, Cairo, Hanoi, Manila etc. are having a huge crowd but very narrow roads and poor traffic maintenance system to regulate those crowds. The transport infrastructure is struggling to keep pace with demand. But before we design any advanced traffic management system, we should look into what are the factors that are causing congestion and how costly are the respective measurements against them. This paper is intended to present a feasibility study on the implementation of the advanced artificial intelligence techniques in the traffic management sectors of the developing countries. It reviews theoretical and empirical work on the determinants on the implementation of automated traffic law enforcement system particularly in the cities of the developing countries.

**Keywords:** Traffic Congestion, Automated Enforcement, Infrastructure, Developing Countries, Safety, Driver, Dhaka.

### 1. INTRODUCTION

Automated traffic law enforcement system is designed to reduce traffic crashes and to improve abidance to traffic laws implementing the use of photographic and electronic technology. The main objective is the effective deterrence of potential violators which could not be achieved by the traditional law enforcement methods. These systems are being used extensively in many countries including Austria, Australia, Belgium, Canada, Israel, Germany, the Netherlands, South Africa, Singapore, Switzerland, Taiwan, USA, UK etc. It is difficult for police to enforce red-light or laser-light encounter because they must follow the offenders through the light to

catch them. This can endanger other pedestrians, cyclists, motorists as well as the police officers themselves.

Considering the traffic system as a whole, including the resources and role of the police, it is clear that, enforcement based on a very high subjective detention probability only, will not be able to achieve even on a satisfactory level of the compliance of all traffic rules. Overall the use of this advanced technology in traffic safety work in both assisting and controlling road user behavior also serves this purpose well.

Every year traffic crashes kill the equivalent of highly populated city and describe the deaths as accidents; something random and unavoidable. But technically, they are not accidents, they are simply collisions with a cause and impacts. More than 80% of identifying factors behind the road accidents are either driver errors of commission or omission. Traffic safety researches show that the decision making of drivers in responding to the yellow signal, especially for those caught in the dilemma zone, is governed by a multitude of traffic, situational, and behavioral factors. Automatic enforcement measures play a significant part in the stopping tendency of drivers. Studies have found that a large and highly significant reduction in red-light violations several months after implementation of the automated enforcement system in USA, Canada, England and Singapore. However, it is likely that the effects of this automated system may differ in other cities of the developing countries. More novel strategies might be required for successful implementation of this system since the factors behind the effective outcome are quite different.

## **2. POPULAR AUTOMATED ENFORCEMENT SYSTEMS**

An automated enforcement system uses an electronic camera to detect infringements and to provide photographic documentation of the vehicle or driver violating the traffic law. The most common ways to implement this system are

- (a) Red-light cameras and
- (b) Automated speed enforcement cameras.

### **2.1. Red-Light Cameras (RLC)**

Red-light cameras are dedicated to taking pictures of the vehicles entering intersections after the traffic signal has turned red. In most instances, Sensors in the pavement detect the offences. These sensors are tied to a timing system that connects the pole-mounted camera and the traffic signal. The camera takes photographs of the vehicle, license plate, and/or driver, usually when the vehicle enters the intersection on red as well as while the vehicle is in the intersection. The photos are further reviewed by local jurisdiction officials such as police officers or by both the camera vendors and the jurisdiction officials. Then the law violating the vehicle's owner or driver may receive a citation. These have been in place in the USA since 1993, and are estimated to be in use over 400 communities.

### **2.2. Automated Speed Enforcement Cameras (ASE)**

Usually, photo radar technology is used to monitor and enforce posted speed limits. ASE system includes:

- **Fixed cameras:** These are some automated cameras without any operator, which continually monitor traffic speeds.
- **Semi-fixed cameras:** these cameras are rotated between housings resulting in housings with active cameras and ‘dummy housings’ without cameras.
- **Mobile camera operations:** These cameras are most often installed in vehicles with or without enforcement agents present.
- **Average speed enforcement system:** These use sensors to measure the average speed between two checkpoints on a roadway.

Both the ASE and RLC can be combined together to achieve better efficiency. In all the ASE systems, a digitally controlled camera takes pictures of the vehicles and the license plate if the vehicle exceeds the enforcement threshold- a set number of miles more than the posted speed limit. It is the responsibility of the camera to record the speed, date, time as well. If the state requires driver liability, comprehensible photographs of the driver are also essential. Then the system mails the citation to the owner of the vehicle, who may be required to identify the offending driver or pay a fine. This Automated Speed Enforcement technology has been installed in the U.S. since 1986 and is in use in 142 communities.

### **3. THE AUTOMATED TRAFFIC ENFORCEMENT CHAIN**

Automated traffic Enforcement works perfectly when the driving people have the perception that they can be monitored for traffic rules violations anytime, anywhere. Moreover, the violators must be notified immediately of a violation. The punishment for a violation which normally includes the payment of a fine needs to be paid promptly and is perceived as high enough to act as a strong disincentive. Administratively fine collection can be a laborious process if the violator has no intention to pay.

Therefore, the following 3 factors have to be very clear to the violators:

- The authorities have accurate and adequate evidence that the violation took place
- There is no alternate of paying the issued fine
- The penalty will increase if the payment is delayed.

The entire automated traffic enforcement process can be viewed as a chain with various separate and interdependent links. This chain starts with the initial detection of a violation and extends to fine payment or in court. The entire system is designed with the following links.

#### **3.1. Detection**

It is done with types of equipment with a high detection rate. Identifying all passing vehicles is mandatory because this is the primary requirement to catch all potentially violating vehicles. Reliable and durable detection methods like inductive loops or modern tracking radars can be used to maintain a consistent high detection rate. There are other methods available such as video, piezo, laser, low mounted radar etc. But some of the methods may suffer from some disadvantages due to the following issues: sensitivity, lighting conditions, obstruction by adjacent vehicles, weather conditions (snow, fog, rain etc.), soiling by precipitation, dirt from

passing vehicles, high maintenance intensity, wear and tear, sensitivity to vandalism and damage etc.

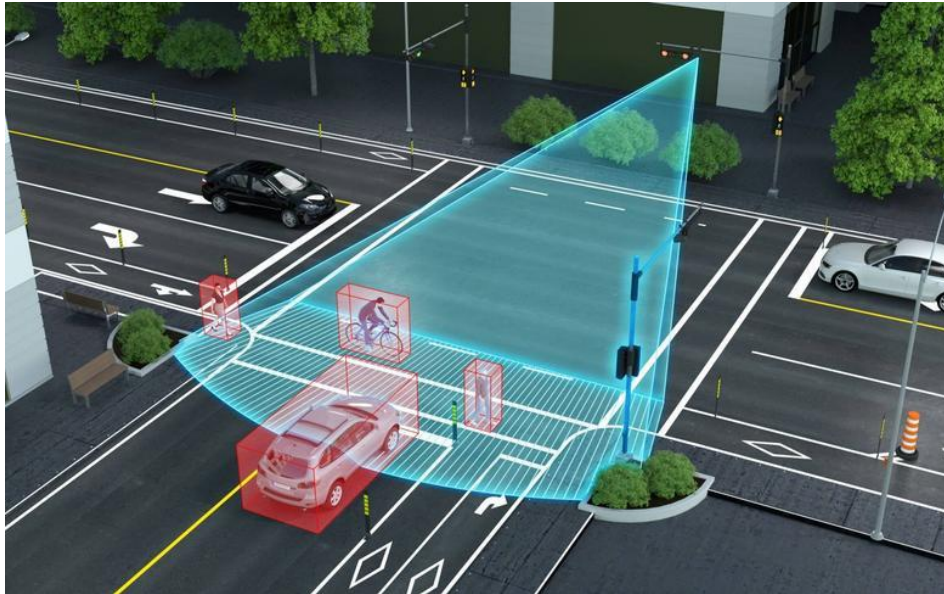


Figure 1: The automated Traffic Enforcement Mechanism

### ***3.2. Measure***

After the detection of a vehicle, its speed needs to be measured correctly with a legally pre-defined accuracy. The most common average speed enforcement systems, section control, calculate speed based on errorless time measurement over a predefined distance and not by measuring the speed at a particular spot.

### ***3.3 A decision on the violation***

When a vehicle is measured exceeding a legally set speed limit, this must be determined as a violation. The decision-making algorithm simply compares the speed values measured by the enforcement cameras with two-speed values; the local speed limit and the registered speed. Concurrent violations can be handled with the latest radar technology and the efficient data processing capacity of the advanced enforcement cameras.

### ***3.4. Register***

Once a positive decision has been taken on a violation, the photographic or video data for the violation need to be registered instantly in a secure, correct and unchangeable way. The use of cryptography is vital while registering the evidence properly. It adds encryption, authentication and integrity to the system. The license plate data from the registered image file are processed and read in the enforcement camera by ANPR software and are integrated into the evidence file digitally. ANPR (Automated Number Plate Recognition) is a technology which uses optical character recognition on pictures and footages to scan vehicle registration plates and form vehicle location data and information.

The quality, clarity, readability, uniformity of a license plate affects the quality of the registered evidence. The AAMVA (Association of American Motor Vehicle Administrators) issued a report with detailed recommendations on several aspects of license plate design. For the governments, good license plate readability improves enforcement efficiency and enhance security as well.

### ***3.5. Transfer***

After registering, the evidence data need to be transferred from the enforcement camera to a central server which can be located with the municipality, central or regional government organization or might be with a private entity depending on the contract. Such data can be transferred by means of Wi-Fi, data line or 3G or 4G mobile broadband connection.

### ***3.6. Storage***

Violation information is transferred to a secure data house or data storage location to issue citation from the back office and is kept for longer-term storage and future reference for the police, violators, police, public prosecutor or judge. These data should be properly backed up and mirrored in reliable robust data centers.

### ***3.7. Process evidence, issue and send a ticket***

The captured pieces of evidence require further processing in the back office so that the notices can be issued and sent to the owner of the violating vehicle. The operations and functionalities in there completely depend on the legal framework and process architecture. The error rate of the manual procedure is considerably higher than the ANPR processing. After justifying the evidence, the authority access the vehicle registration database to match license plates with the owner's addresses and process the penalties.

Countries like France and Netherlands are able to annually process millions of violations from automated enforcement systems without human intervention with the help of a combination of administrative law, clear license plates, high definition enforcement cameras, effective ANPR software and owner liability etc.

### ***3.8. Receipt of ticket***

After sending out just a citation by means of the post is an excellent opportunity for the violators to ignore the penalty by refusing acceptance of registered mail. Therefore, the authorities include email addresses and mobile phone numbers in the vehicle registration database. If the violator doesn't pay within the due time, the detection should be implemented in toll points and traffic points to block that particular vehicle above the road.

### ***3.9. Provide evidence upon violator's request***

While providing violation evidence to the owners, other relevant information can also be shown. A key aspect that should be presented to a violator is targeted publicity on why enforcement takes place on that specific location. For example "Your Maruti Suzuki Swift DZire with the number plate "WB 38Y 5400" was found to cross the maximum speed limit while passing Marqui's Street on 3rd January 2019. Our enforcement system cares for your precious life since, 4 casualties, 5 injuries and 8 crashes occurred on the same street in the past 2 years." Such

specific publicity contributes to an automated traffic enforcement system being seen as a road safety measure and rather not as a revenue generator for the government.

### 3.10. Court

If all the above fails, the violator must know that a judge will ultimately cast a final verdict at the end of this traffic enforcement chain. The authority should support the public prosecutor and the judge by typed approval, verification and calibration certificates in their judgment.

## 4. MEASUREMENT OF SAFETY

To analyze the feasibility of the proposed system in a city of third world country, we must have data and quantitative formulae to calculate the traffic safety. The Haddon Matrix is commonly used worldwide to approach safety analysis in a systematic way. In 1980, William Haddon first came with the idea of this two-dimensional model which applies basic principles of public health to motor vehicle-related injuries. The first dimension represents the phases of injury and the second dimension deals with the four factors of injury: Human, equipment/ vehicles, socio-economic impact and the physical environment.

This model is an extremely effective tool to identify where and when to implement traffic safety countermeasures, to plan crash-related data collection and to identify agencies or organizations for collaborative efforts.

Table 1: Haddon Matrix

	<b>Human</b>	<b>Equipment/ Vehicles</b>	<b>Physical Environment</b>	<b>Socioeconomic</b>
<b>Pre-Crash</b>	Poor vision or reaction time, speeding, alcohol, risk-taking	Failed brakes, missing lights, missing traffic signs, lack of warning systems	Ill-timed signals, Narrow Shoulders	DUI (Driving under influence), OWI (Operating while intoxicated), Cultural norms permitting speeding, Red light running
<b>Crash</b>	Failure to use ORC (Occupant Restraint Controller)	Poorly engineered airbags, malfunctioning safety belts	Poorly designed guard rails	Lack of vehicle design regulations
<b>Post-Crash</b>	High vulnerability, alcohol	Poorly designed fuel tanks	Poor emergency communication systems	Lack of support for Emergency medical service and trauma systems.

The Haddon Matrix above can be constructed from a set of crashes in an urban area. The pre-crash/Human cell identifies potential modifications to driver behaviors that may reduce the severity of a collision. The matrix itself provides a range of prospective issues which can be addressed through a variety of countermeasures, including the 4Es of Safety; Engineering, Enforcement, Education and Emergency response solution.

## **5. PRESENT TRAFFIC SCENARIOS**

Relevant data has been collected from the ongoing studies on traffic management in a few cities of the developing countries. These data have been used to generate infographic representation of the present situation of the traffic of these cities.

### **5.1. Traffic Index**

It's a composite index of the time consumed in traffic because of job commute, CO2 consumption estimation in traffic, estimation of time consumption dissatisfaction and overall inefficiencies in the traffic system.

To calculate the design Traffic Index, the following equation is used.

$$TI = 9.0 (ESALs/10^6)^{0.119}$$

Here,

TI = Traffic Index,

EASL = Equivalent Single Axle Load

### **5.2. Time Index**

It's an average time needed in a one-way transport, calculated in minutes.

Time Expected Index: It is an estimation of the dissatisfaction level due to long commute times. It is assumed that the dissatisfaction of commute times increases exponentially with each minute after one way commute time is longer than 25 minutes.

### **5.3. Inefficiency Index**

It is an estimation of inefficiencies in the traffic. High inefficiencies are typically caused by the very fact that people drive a car rather than using public transport or long commute times. It is often used as a traffic measurement component in economies of scale.

Table 2: Present traffic scenarios of various countries

<b>Name of the City</b>	<b>Country</b>	<b>Traffic Index</b>	<b>Time Index (in minutes)</b>	<b>Time Expected Index</b>	<b>Insufficiency Index</b>
New Delhi	India	271.78	55.24	10638.67	300.92
Dhaka	Bangladesh	263.76	58.09	13580.04	331.94
Jakarta	Indonesia	261.60	53.78	9308.09	293.28
Istanbul	Turkey	245.19	52.04	7861.45	257.96
Lima	Peru	226.28	50.20	6494.46	272.86
Bangkok	Thailand	208.13	44.43	3223.11	258.79
Bogota	Colombia	197.42	47.91	5027.18	203.30



## 6. REAL-TIME TRAFFIC IMAGE:

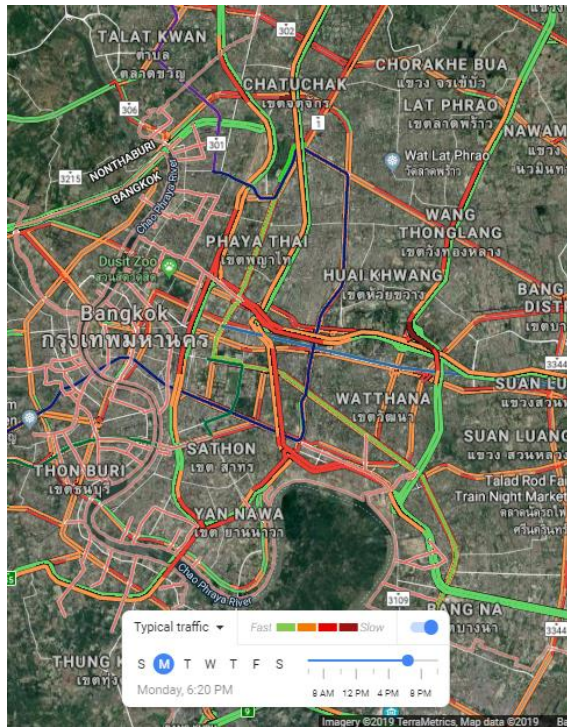


Figure 2: The typical traffic in Bangkok

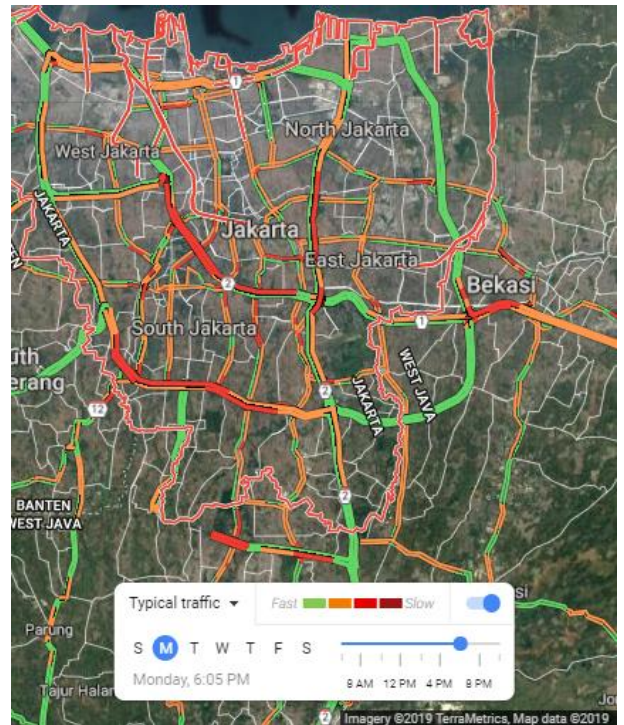


Figure 3: The typical traffic in Jakarta

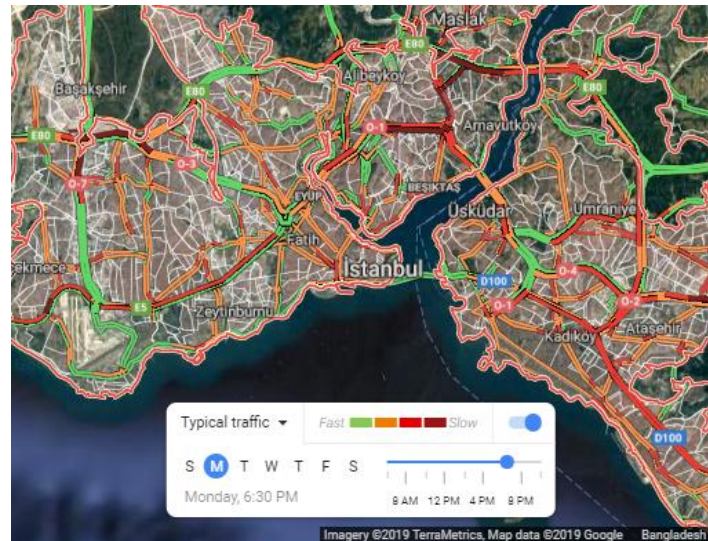


Figure 4: The typical traffic in Istanbul



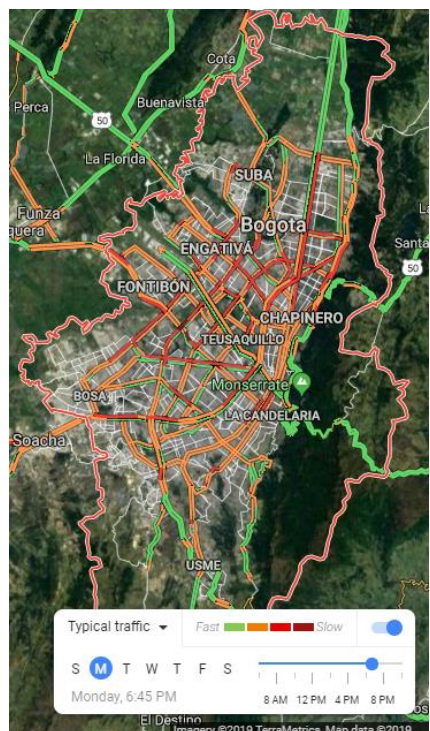


Figure 5: The typical traffic in Bogota

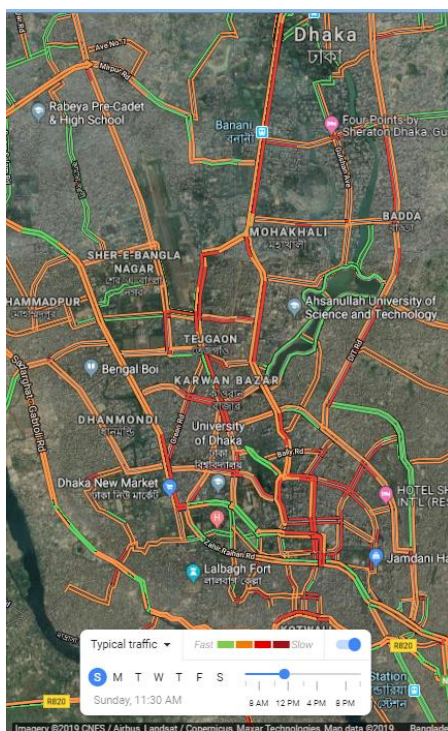


Figure 6: The typical traffic in Dhaka

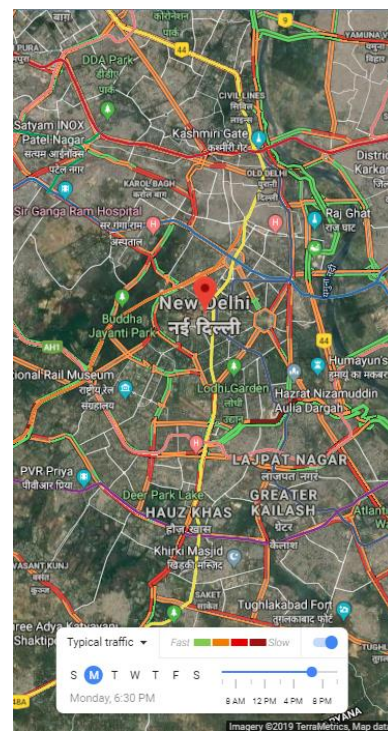


Figure 7: The typical traffic in New Delhi

## 7. GLOBAL STATUS REPORT ON ROAD SAFETY 2018

Although the number of road traffic deaths continued to climb at 1.35 million in 2016, the rates of death relative to the world's population has stabilized in the last few years. The data presented in the new report of 2018 shows that some countries have made progress.

The following table represents the top 10 countries the highest road traffic death rates.

Table 3: Countries with the highest estimated road traffic death rate

Countries with the highest estimated road traffic death rate, 2018		
Rank	Country	Rate (per 1 lakhs)
1	Liberia	35.9
2	Sri Lanka	35.4
3 (combined)	Burundi, Zimbabwe	34.7
4 (combined)	Democratic Republic of Congo, Venezuela	33.7
5	Central African Republic	33.6
6	Thailand	32.7
7	Burkina Faso	30.5
8	Namibia	30.4
9	Cameroon	30.1
10	Mozambique	30.1

All of these 10 countries belong to the list of developing countries according to the International Monetary Fund's World Economic Outlook Database, 2018.

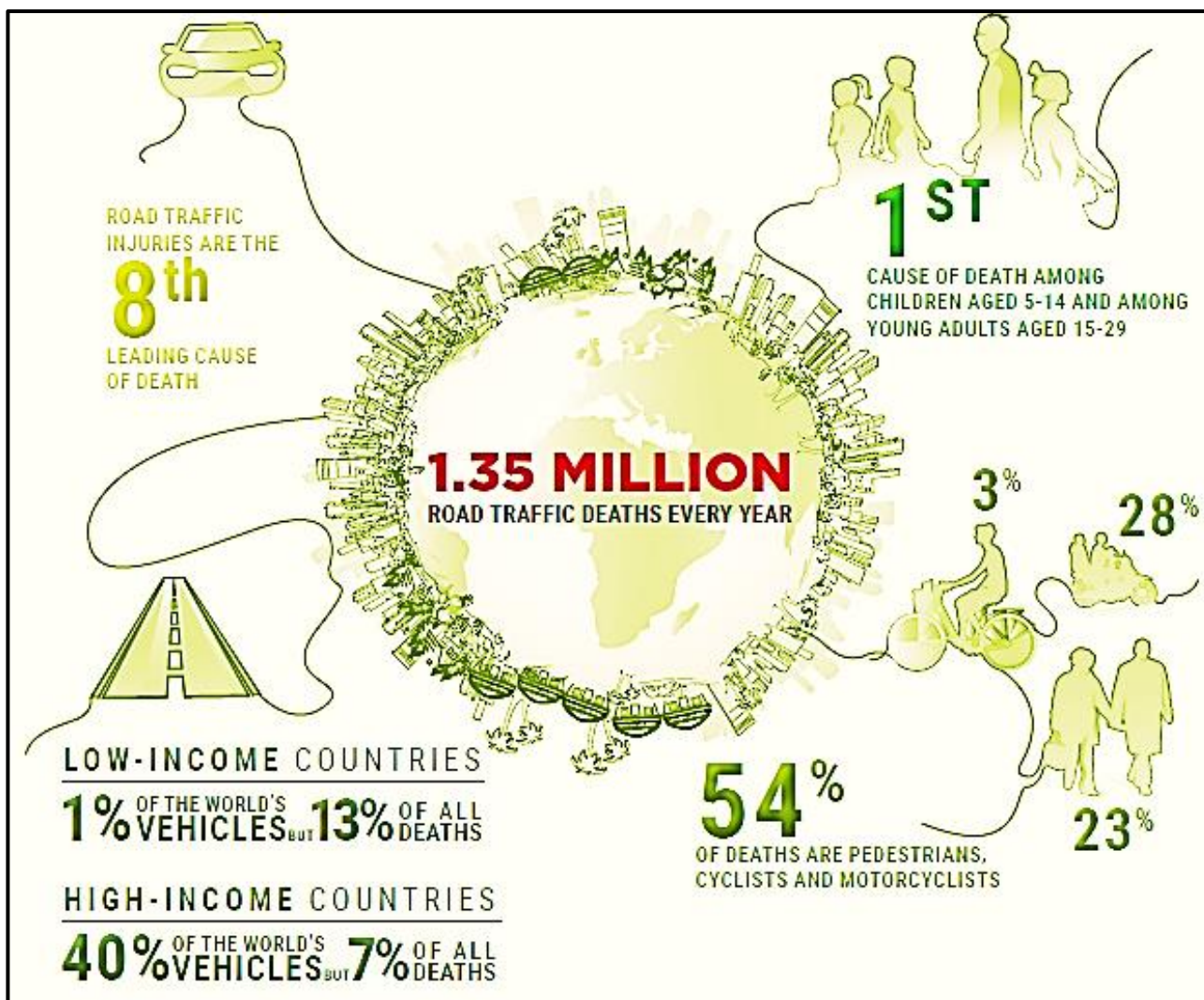


Figure 8: Info graphic presenting the injury rates, 2018

Therefore, we can assume that progress has not occurred at a pace fast enough to compensate for the growing population and rapid motorization of transports taking place in the cities of developing countries.

If we compare the previous report series released in 2015, we can find the following outcome:

- a. **22 further countries** modified their laws on one or more risk factors to bring them in line with best practice which covers an additional **1 billion people**.
- b. The number of countries which presently have laws setting speed limits that align with best practice is **46** covering a population of **3 billion people**.
- c. The number of countries which presently have laws regarding drink-driving aligning with best practice is **45** covering a population of **2.3 billion people**.
- d. The number of countries which presently have laws regarding the use of helmet on motorcycles aligning with best practice is **49** covering a population of **2.7 billion people**.
- e. The number of countries which presently have laws regarding the use of seat-belts aligning with best practice is **105** covering a population of **5.3 billion people**.
- f. The number of countries which presently have laws regarding the employment of child restraint systems aligning with best practice is **3** covering a population of **652 million people**.
- g. The number of countries which are presently undertaking some systematic assessments or star rating of existing roads is **114**.
- h. The number of countries which presently have enforced a minimum seven or all of the eight priority UN vehicle standards are only **40** covering a population of **1 billion people**.
- i. More than half of the **countries (62%)** have a phone number having a full country coverage to actuate the emergency care system.
- j. **55%** of the countries have a proper method to upskill and certify pre-hospital care suppliers.



Figure 9: Info graphic presenting the reduction of death rates



There exists a disproportionate risk. Low and middle income countries bear an inordinate burden of road traffic deaths.

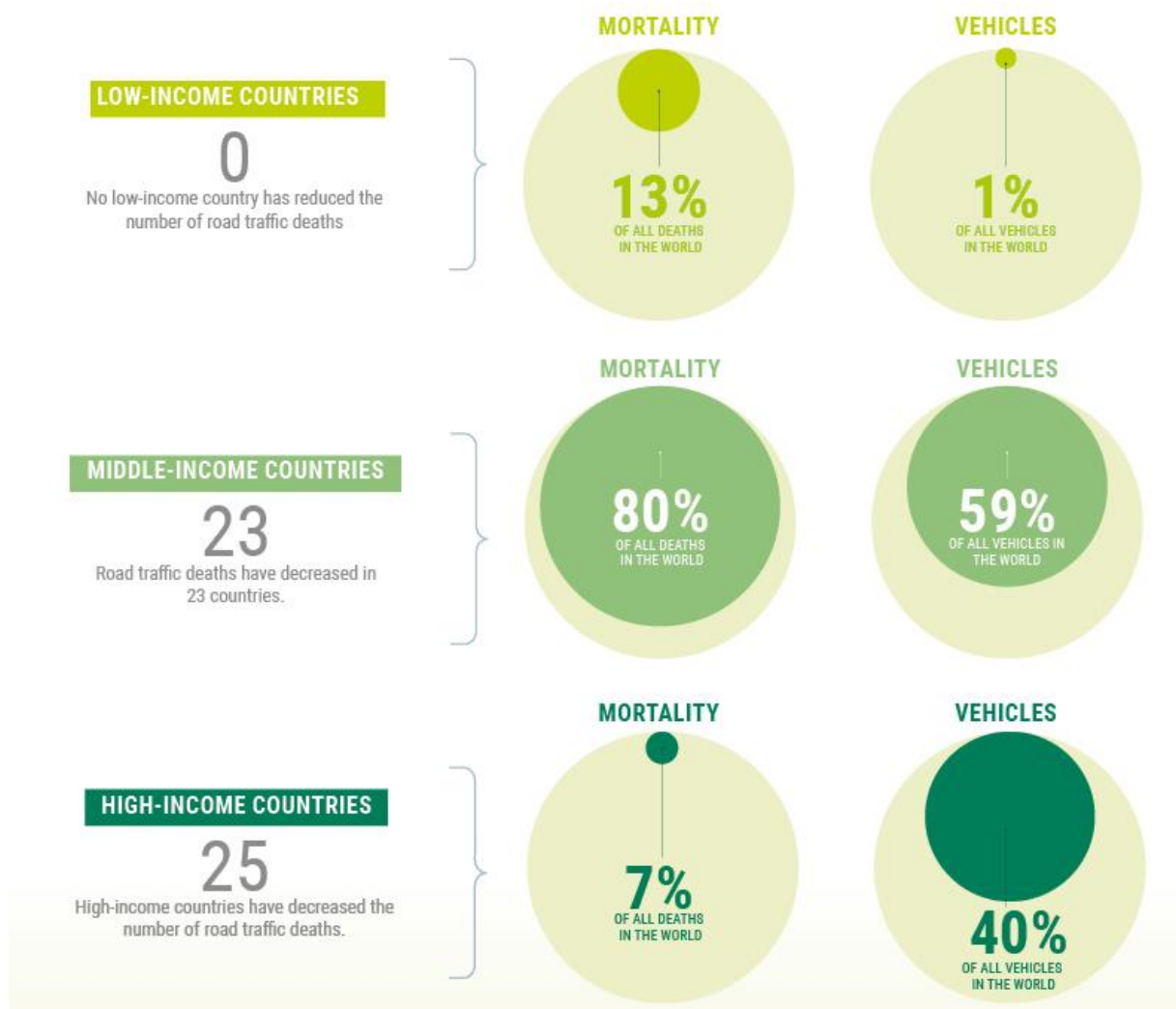


Figure 10: Info graphic presenting the mortality rate in low and middle income countries

Strong road traffic laws, when adequately enforced, ensure safe behaviors and make roads safer. In the past 3 years, 22 countries have amended their road safety laws to align with the WHO's recommendations. This resulted in 1 billion additional people being covered by effective road traffic laws.

The following info graphic represents the result found in cognitive studies.

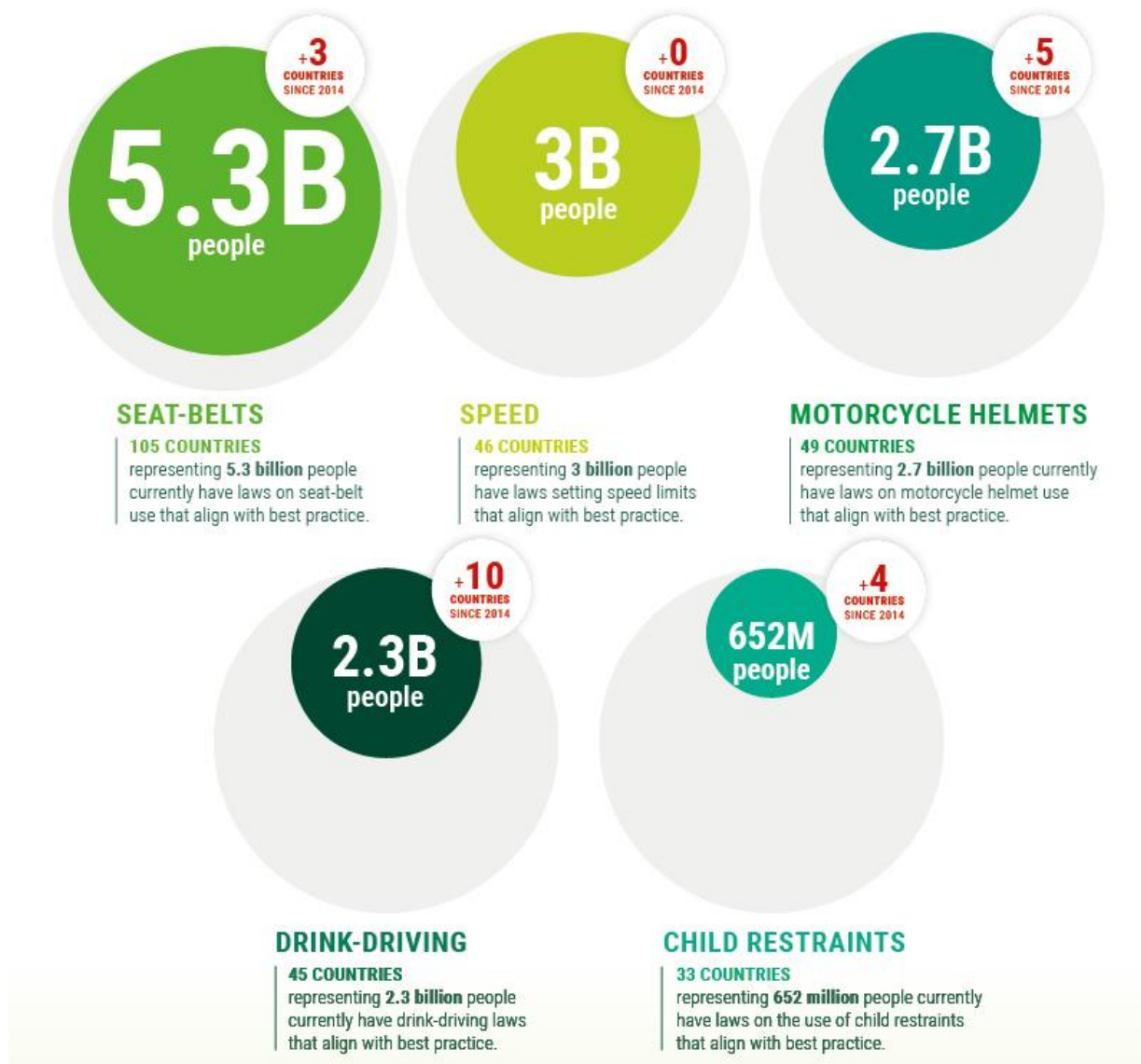


Figure 11: Primary reasons of maximum accidents

## 8. COGNITIVE CAUSES OF TRAFFIC SCENARIO

In most of the cities of low and middle income countries the following occurrences are noticed.

1. The urban transportation sector in maximum cities is developed without much major support or influence from the central government.
2. There are markable lacking of crucial personnel in planning, management, traffic operation and safety jobs.
3. In the transportation sector, the plans that are made are not long-term in real.
4. Most of the urban transports are heavily deregulated and “messed up”.

5. Informal bus and other public transports are fiercely compete motivated by profits.

In a recent study, the ARI (Accident Research institute) of Bangladesh University of Engineering and Technology established the following causes for the traffic system in **Dhaka, Bangladesh** being so ineffective:

- a. Dhaka's transport responsibility is fragmented between DNCC, DSCC, DTCA, RHD, BRTA, RAJUK, BRTC, LGED as opposed to one central regulatory body or multiple coordinating regulatory bodies.
- b. Absence of an integrated public transport system.
- c. Negligence towards the intrusion of hawkers, construction, illegal parking etc.
- d. Remiss enforcement of public safety inroads.
- e. Absence manpower.
- f. No clear and sustainable source of financing.
- g. Subsidies for public transports are absent.

After studying the traffic condition of **Mumbai, India**, the following issues can be found:

- a. Mumbai is a metro city. Urbanization is imbalanced in the city according to its population growth.
- b. Mumbai's population is more than 23.5 million according to the recent data. This population is also increasing at a rainless rate. Each road has to deal with a vehicle flow above the capacity.
- c. A fair majority of Mumbai's population have personal vehicles. At least 49% of the total vehicles on Mumbai's road are private cars and 28.4% are two-wheelers.
- d. Uneven roads around the city are one of the major factor causing so much of the traffic jams.
- e. None of the vehicles moves with constant speed or any gradual acceleration or de-acceleration. This scenario is making haphazard unorganized vehicles' queue.
- f. The entire city is full of a huge number of auto-rickshaws. These drivers take shortcuts, overtake from the wrong side, compete on the road and are simply uncontrollable by the enforcement alone.
- g. The climate of Mumbai is very calamities friendly. Sometimes heavy rains, floods etc disrupt the locomotion.

There are many factors which contribute to traffic problems in **Jakarta, Indonesia**:

- a. The growth rate of the vehicles exceeds the growth rate of the number of roads.
- b. Public transports are not suitable. Jakarta is still served by 16000 angkots which could be minimized. Many outdated buses like metro-mini need to be replaced by modern bus service.
- c. There are so many bottleneck points in the roads of Jakarta; for instance, in toll road entrances, road intersections, mall entrances etc.
- d. Many people cross the road carelessly and disorderly, even if there exist few zebra cross and foot over bridges.
- e. Interrogation between multiple modes of transport isn't optimal.
- f. Many people don't use public transport because no feasible route exists to their destination. That is also a factor to drive people to use private vehicles.



- g. Angkots and buses pull off and park in the middle of the road or anywhere they want to without following the rules.
- h. Poor policymaking tends to aim for a short-term goal and lacks long term planning.
- i. A good number of people can afford to buy and maintain personal motor vehicles. Too many drivers/motorcyclists get their license instantly without proper traffic knowledge.
- j. Traffic law enforcement authority is not strict and effective enough, which results in a population which is in general very bad at obeying laws.

The following causes can be found to affect the traffic condition of **Douala**, the economic and commercial capital of **Cameroon**:

- a. The road infrastructure in Douala is inadequate to accommodate the total number and weight of the vehicles around the city.
- b. The narrow and poorly paved roads are filled with potholes making it difficult for the drivers to move in relax.
- c. The overpopulated city is planned efficiently to serve the swift locomotion of such a huge number of people.
- d. Road users are always in a hurry and nobody wants to let another driver go first. This result in indiscipline and reckless driving causing intolerable traffic jams.
- e. The urbanization happened without proper planning of the city structure. Therefore whenever the government wants to build flyovers, roads, bypass or highways, compounded by the rains, these construction sites considerably slows down the movements of cars, pedestrians and goods in Douala.

## **9. FEASIBILITY ANALYSIS**

From the above para, it is clearly understandable that the conditions of our considered cities are no way even nearer to the traffic state of the cities innovating the automated traffic enforcement systems. There would be the following challenges be noticed.

- a) **Inadequate financial support:** This is the first and foremost challenge to implement the proposed system. Unlike the developed cities, these cities are not financially solvent enough to invest such a big amount on the project of an automated traffic enforcement system which may even result in practically NULL efficiency. The government itself or with external financial support can, however, implement testing prototypes, but there is a huge chance that the same system may give a different result on the neighboring area.
- b) **Outlaw Citizen:** We are discussing automated enforcement in such areas where a large number of people are not even aware of the proper traffic laws to be followed. Some people know the rules and follow, but they also find it beneficial not to follow the rules when they are in a hurry. The enforcement system itself is not effective enough. The drivers, motorcyclists or pedestrians know well that there won't be many hazards if they are caught against the law. Sometimes they bypass the issuing of the case by offering bribes.

- c) **Acknowledgement of the drivers and pedestrians:** Most of these countries have a low literacy rate. When a new system is implemented in a city, the city dwellers need to be acknowledged well about the use, productivity, impacts, mechanism etc of that system. The licensing and registration database is updated manually but not in digital manners. It's way too tough to track the vehicles as well as the drivers. The drivers in most cases are not literate enough and they cannot be acknowledged by leaflets, brochures, pamphlets or signboards. They don't have much time in their hands to listen to radios or watch televisions. The only way these people can be made to attend any workshop or seminar is if they are paid which is not even a worthy solution.
- d) **Narrow and congested roads:** There are so many narrow and congested roads available in these cities. When the automated system is implemented on a broader road with efficient vehicle management it may give good results. The same system may fail or result in rather more congestion in the other roads where various kind of vehicles have been creating chaos from long ago.
- e) **Insufficiency in long-term goal:** The traffic management authority and enforcement squad don't have any long-term sustainable plans with the transportation committee. Political issues are the culprits behind this lacking. The political figures like the transport minister or mayor can super head the initiatives, take the responsibilities and be accountable to the public.
- f) **Insufficient Public Transports:** Adequate traffic management and efficient public transportation together can reduce at least 60% of the impacts and losses created by traffic hazards. The safety in public transports is also a major factor here. For starters, sexual harassment on public transportation is fairly commonplace. There have been many cases of notorious rapes on moving buses. Women, children and the elderly face tremendous difficulties while riding public transportation due to cramped conditions and hasty vehicles.
- g) **A special diversion for the construction sites:** Governments are continuously trying to minimize the traffic congestions introducing new roads, flyovers, bridges, bypasses etc. But, construction sites usually create extra chaos and traffic overcrowding. Considering such roadways, the installation of speed tracking cameras is beyond imagination.
- h) **Security:** Every technology comes with privacy and security issues. The authentication and authorization in the data centers should be reliable and robust. Proper encryption algorithms should be implemented so that the security cannot be bypassed by the attackers.
- i) **Dependency:** The success and the failure of an automated enforcement system in a city of developing country totally depends on all the other major factors causing the traffic crisis. If the infrastructure is developed enough, people become respectful to the laws, the

traffic authorities support the honest regulations, only then it would be possible to install and utilize the advancement of technology to reduce the traffic congestions. The government should incorporate an institution which will be solely responsible for all transport-related activities in a city. This agency should also develop plans and policies in addition to developing public transportation and dedicated bicycle and pedestrian networks to support standard public transport routes.

- j) **Maintenance:** The proposed system requires very exorbitant maintenance. The climatic situation sometimes becomes an obstacle to the situation. There is also a need for a demonstration to the public, politicians and interest groups that automated systems have an important safety role and are not just a tool to raise additional revenue from the motorists.

## CONCLUSION

Enforcement is traditionally unpopular and technologies that aim to impose driver moderation through 'spot camera' enforcement at specific locations are particularly resented. Based on the overall findings of the study it can be assumed that an automated traffic law enforcement system solely can never solve the entire traffic congestions and the caused hazards in a developing city. But that doesn't mean the introduction of the system in such cities is an insane idea. Although some cities in India like New Delhi, Mumbai, Kolkata etc. are trying to grab the benefits of this system. Although the speed cameras are working well, traffic enforcement hasn't been automated yet. But with proper planning and collective efforts of the enforcement authorities and the city dwellers, it will be possible to achieve the desired outcomes.

## REFERENCE:

- [1] Ashrafur Rahman, AKM Fazlul Hoque [2018], "*Traffic Congestion in Dhaka City: Potential Solutions*", European Journal of Social Sciences Studies, Volumes 2, Issue 12, Page 121- 135.
- [2] Palash Chandra Das, Neeti Zaman Binte, A K. Azad and Tushar Kanti Roy [2019], "*Traffic Congestion Induced Copst of a road section: A study on Fulbari Gate to Dhaka Bangla Midlock, Khulna*", Journal of Engineering Science 10(1), 2019, Page 103 -112.
- [3] John S. Adams, Barbara J. VanDrasek, [2009], "*Automated Enforcement of Red-Light Running & Speeding Laws in Minnesota: Bridging Technology and Public Policy*", Intelligent Transportation Systems Institute, Center for Transportation Studies, University of Minnesota.
- [4] Njimanted, Godfrey Forgha; Mbohjim Othniel Mobit [2013/2014], "*Determinants of Traffic Congestion in the Metropolis of Douala, Cameroon: An integrated approach*", REVUE DE L'ACADEMIE DES SCIENCES DU CAMEROUN Vol. 11 No. 2 & 3 (2013/14), Page 209- 221.
- [5] H.G. Overman, Anthony J. Venables, [2005], "*Cities in the developing world*", UK Department for International Development.

- [6] Robert P. Maccubbin Barbara L. Staples Dr. Arthur E. Salwin [2001], “*Automated Enforcement of Traffic Signals: A Literature Review*”, Federal Highway Administration.
- [7] Fridulv Sagberg [2000], “*Automatic enforcement technologies and systems*”, The ”Escape” Project Contract No.: RO-98-RS.3047.
- [8] Ilona Buttler [2016], “*Enforcement and support for road safety policy measures*”, ESRA thematic report no. 6 Research report number: 2016-T-06-EN.
- [9] “*New WHO Report Highlights Insufficient Progress to Tackle Lack of Safety on the World’s Roads*” [2018].
- [10] Trevor Ellis, Colin Wilson, Neal Skelton [2009], “*Traffic Law Enforcement Technology in the UK*”, ITS United Kingdom.
- [11] Bryan Poole [2012], “*An Overview of Automated Enforcement Systems and Their Potential for Improving Pedestrian and Bicyclist Safety*”, Federal Highway Administration and the National Highway Traffic Safety Administration under Cooperative Agreement No. DTFH61- 16-H-00029.
- [12] Soole, D. W., Watson, B. C., & Fleiter, J. J. (2013). “*Effects of average speed enforcement on speed compliance and crashes: A review of the literature. Accident Analysis & Prevention*”, 54, 46-56.
- [13] Thomas, L., Srinivasan, R., Worth, M., Parker Jr., M. R., & Miller, R. (2015). “*Speed Management Toolkit: Action Plan Development Package*”. Prepared for Federal Highway Administration (FHWA).
- [14] “*National Highway Traffic Safety Administration (NHTSA)*”. (n.d.) FARS Encyclopedia (2016).